



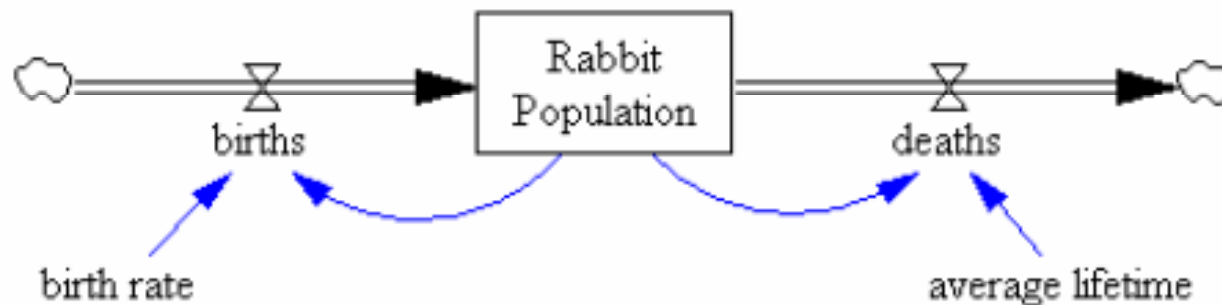
# Vensim Chapter 6

## **Building a Simulation Model**

# Naming Conventions

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- ▶ Levels – initial capital letters; e.g., *Population*
- ▶ Rates, auxiliaries, constants, lookups, data variables – all lower case; e.g., *average lifetime*

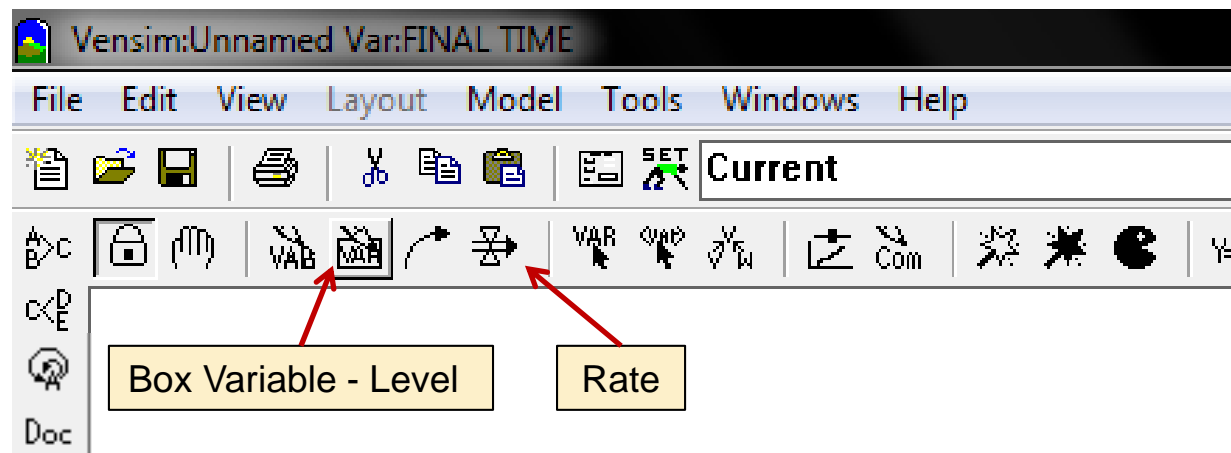


# Sketch Conventions

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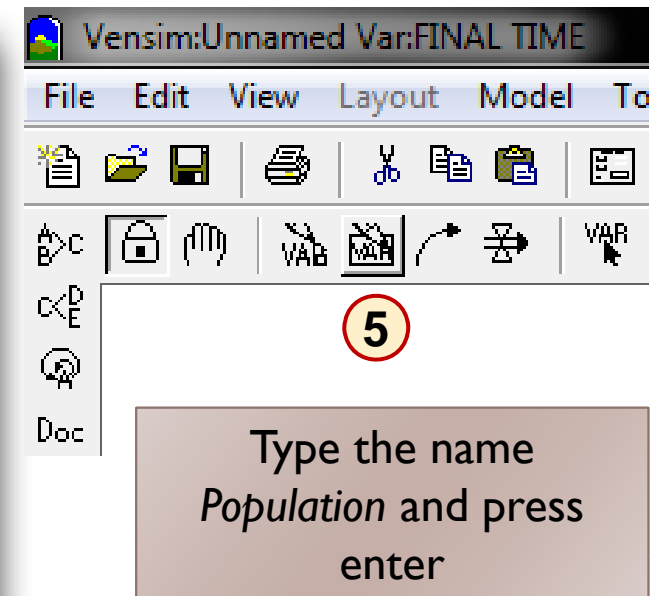
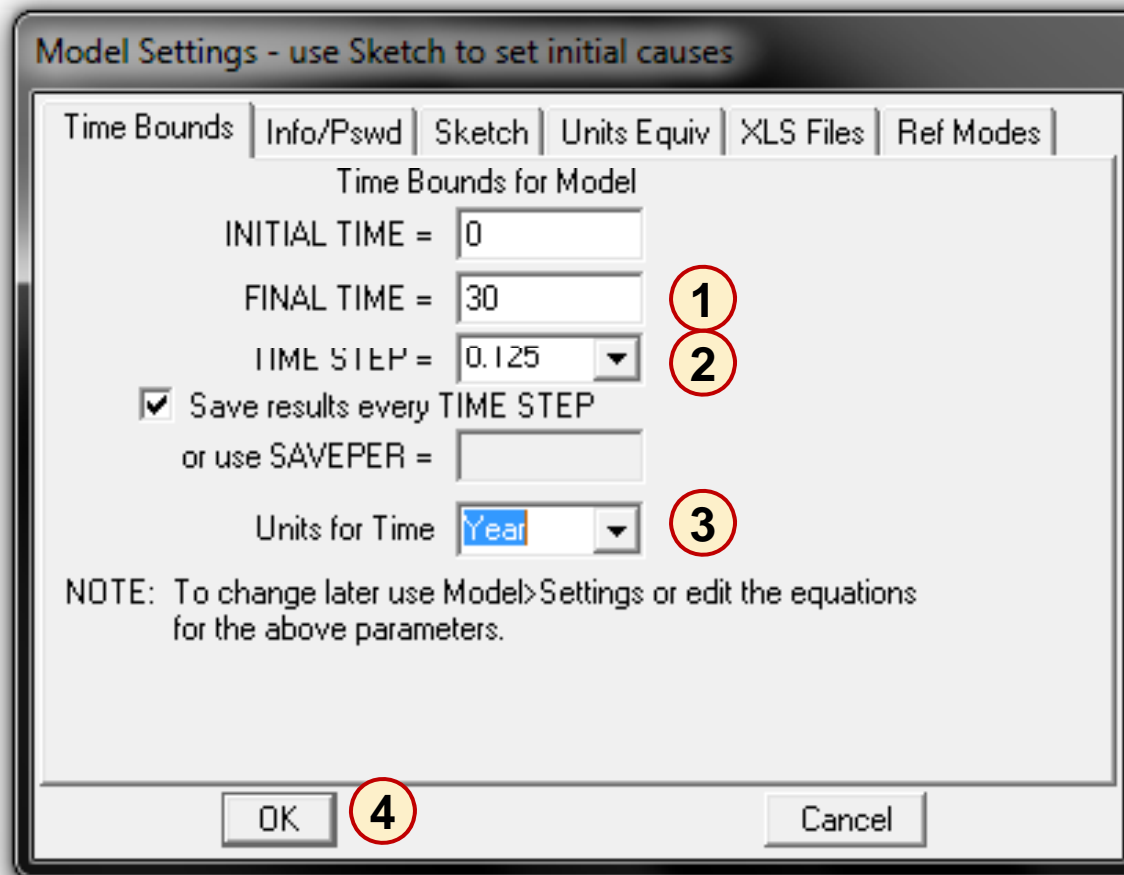
## ► Sketch Conventions

- Levels or stocks are entered with the **Box Variable** tool
- Rates are entered with the **Rate** tool

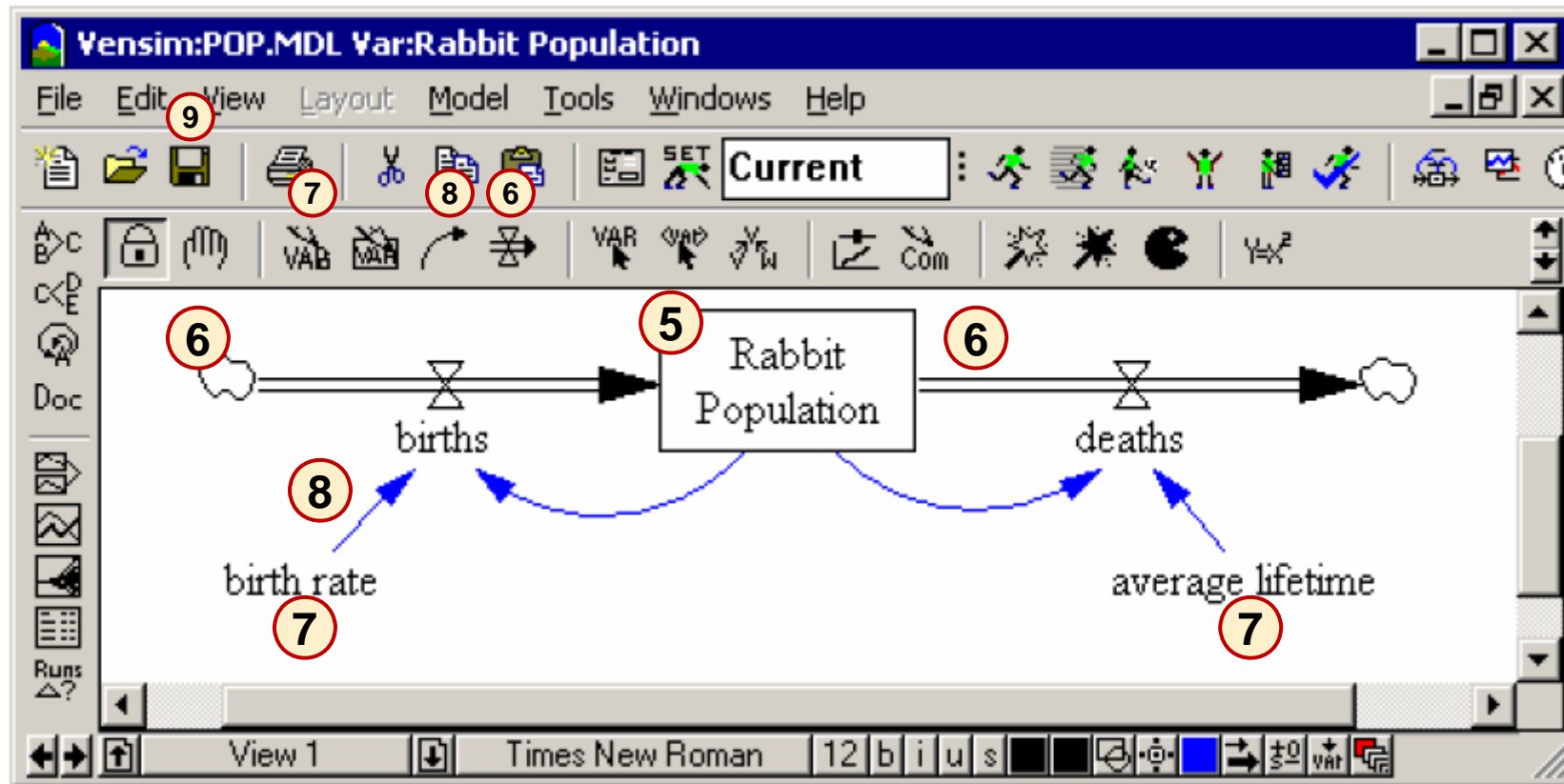


# Sketching the Rabbit Model

## ► File > New Model



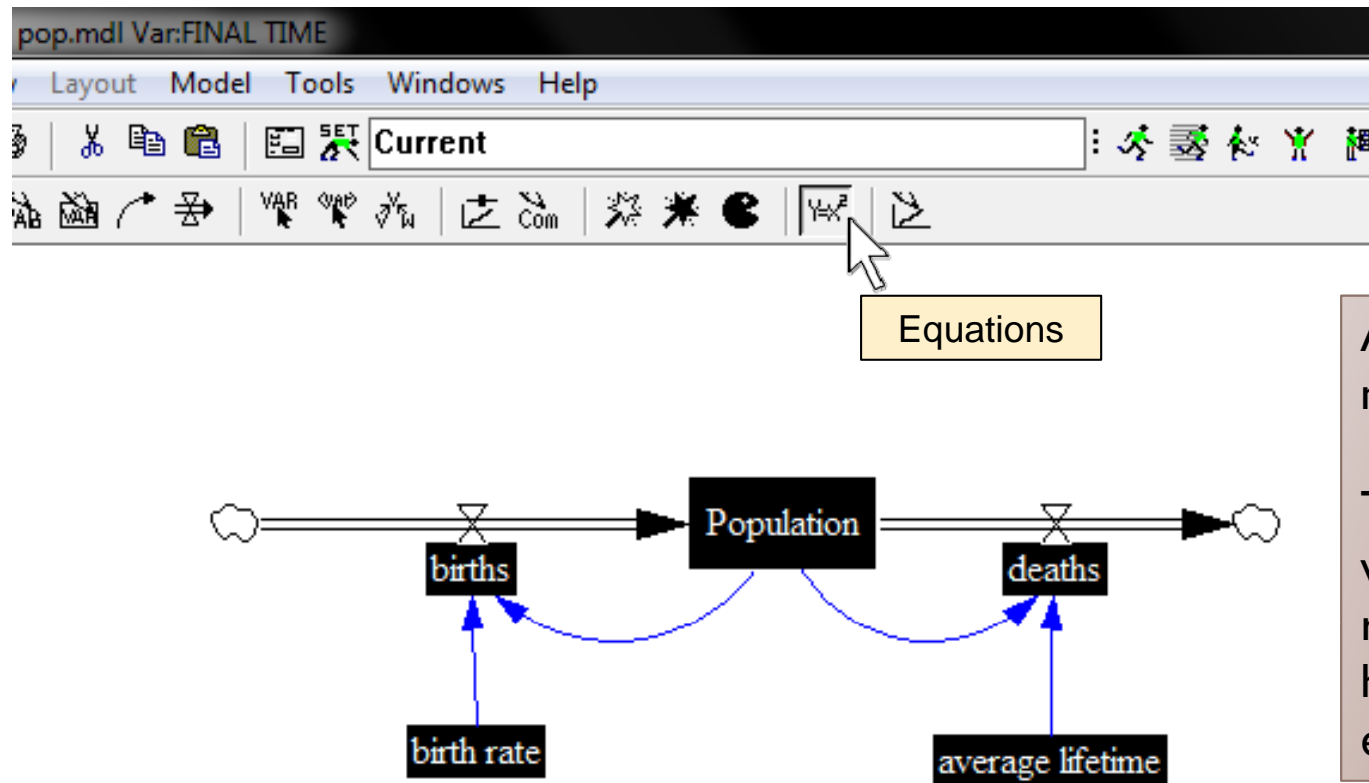
# Sketching the Rabbit Model



- ▶ A positive feedback loop from Population to births increases Population, and a negative feedback loop from deaths decreases Population

# Writing Equations

- ▶  $\text{births} = \text{population} * \text{birth rate}$
- ▶ *Birth rate* has not causes; it is constant in the model

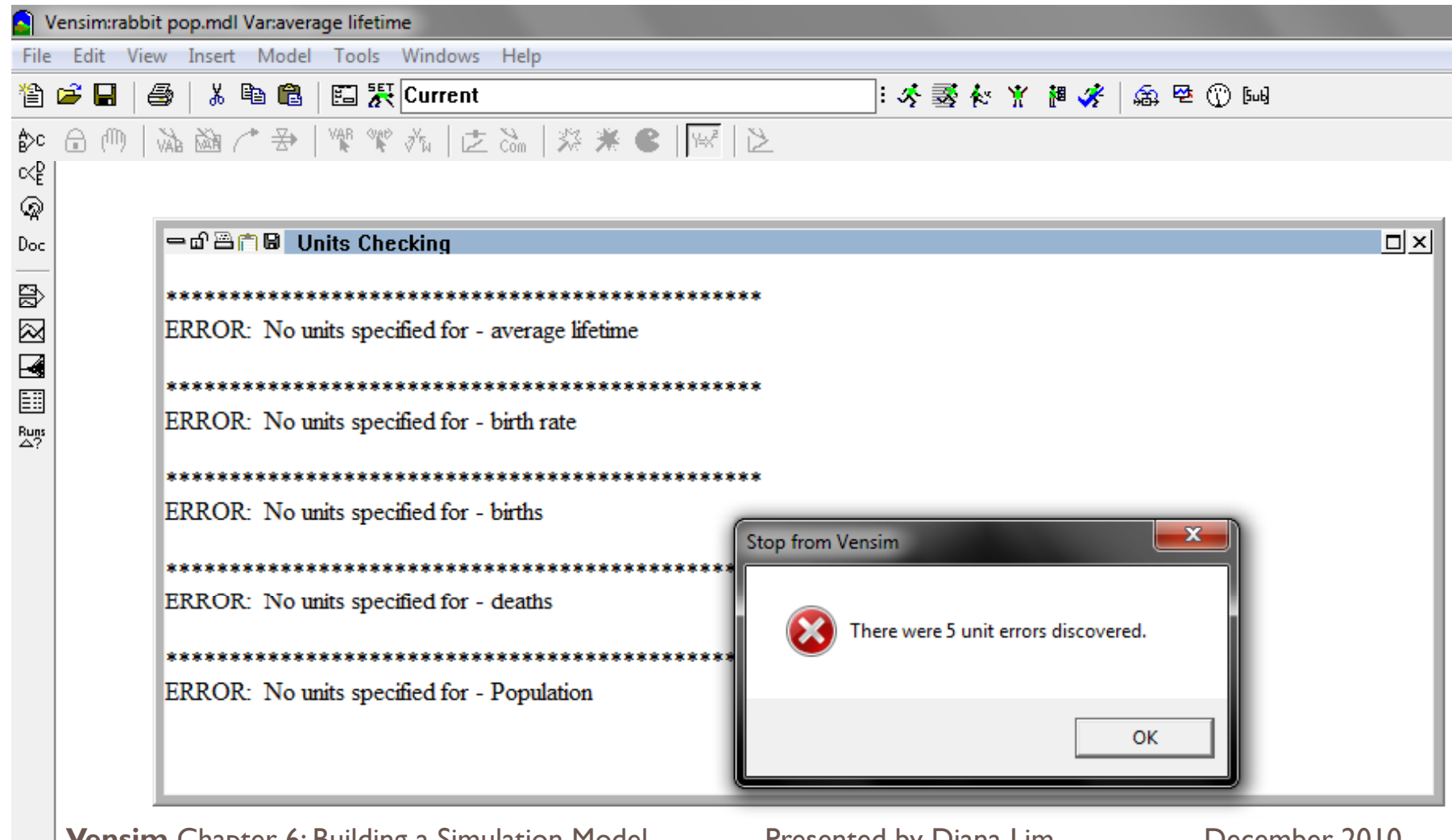


All the variables in the model will turn black.

The highlights indicate which variables still require equations or have incomplete equations

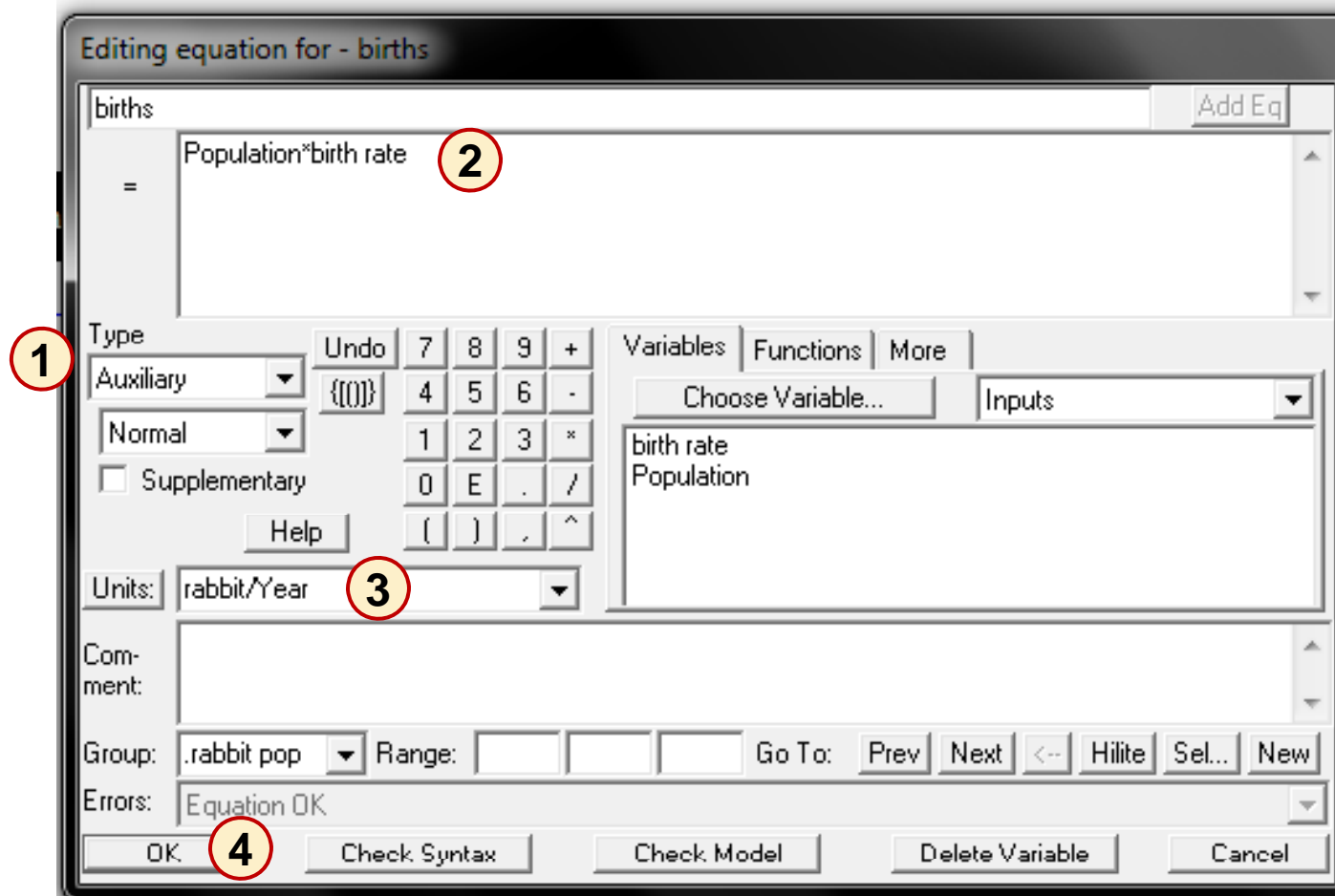
# Checking your model

## ► Model > Units Check



# Variable Type: Auxiliary

- Click on variable *births*





# Variable Type: Level

- Click on variable *population*

Editing equation for - Population

Population = INTEG (births-deaths, 1000)

Initial Value: 1000

Type: Level

Normal

☐ Supplementary

Units: rabbit

Comment:

Group: .rabbit pop Range: Go To: Prev Next <-- Hilite Sel... New

Errors: Equation Modified

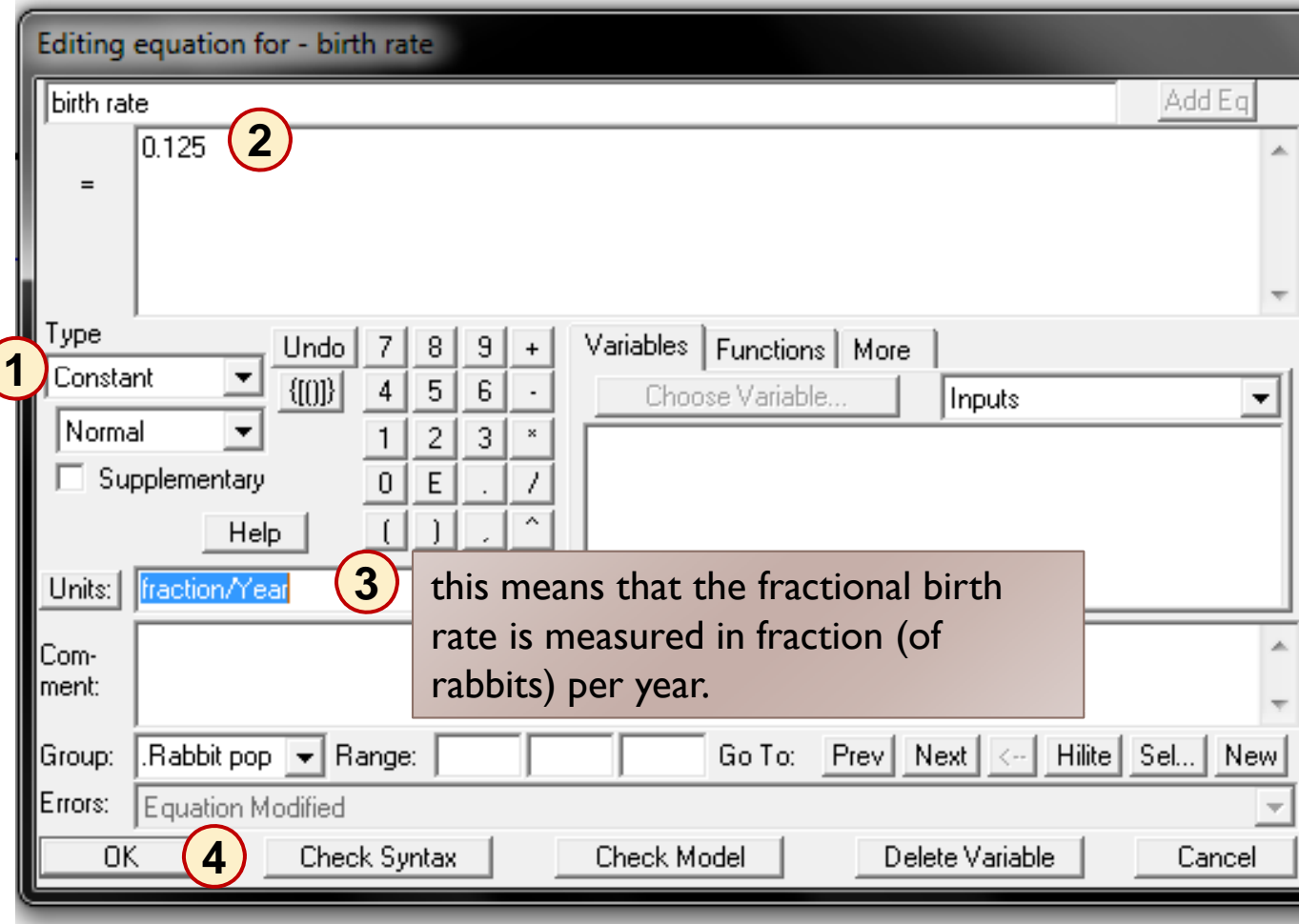
OK Check Syntax Check Model Delete Variable Cancel

equation is already present in the equation editing box

Rates constructed by clicking first outside, and then on the Level are considered positive (inwards) flows; rates constructed by clicking on the Level, and then outside the Level are considered negative (draining) flows

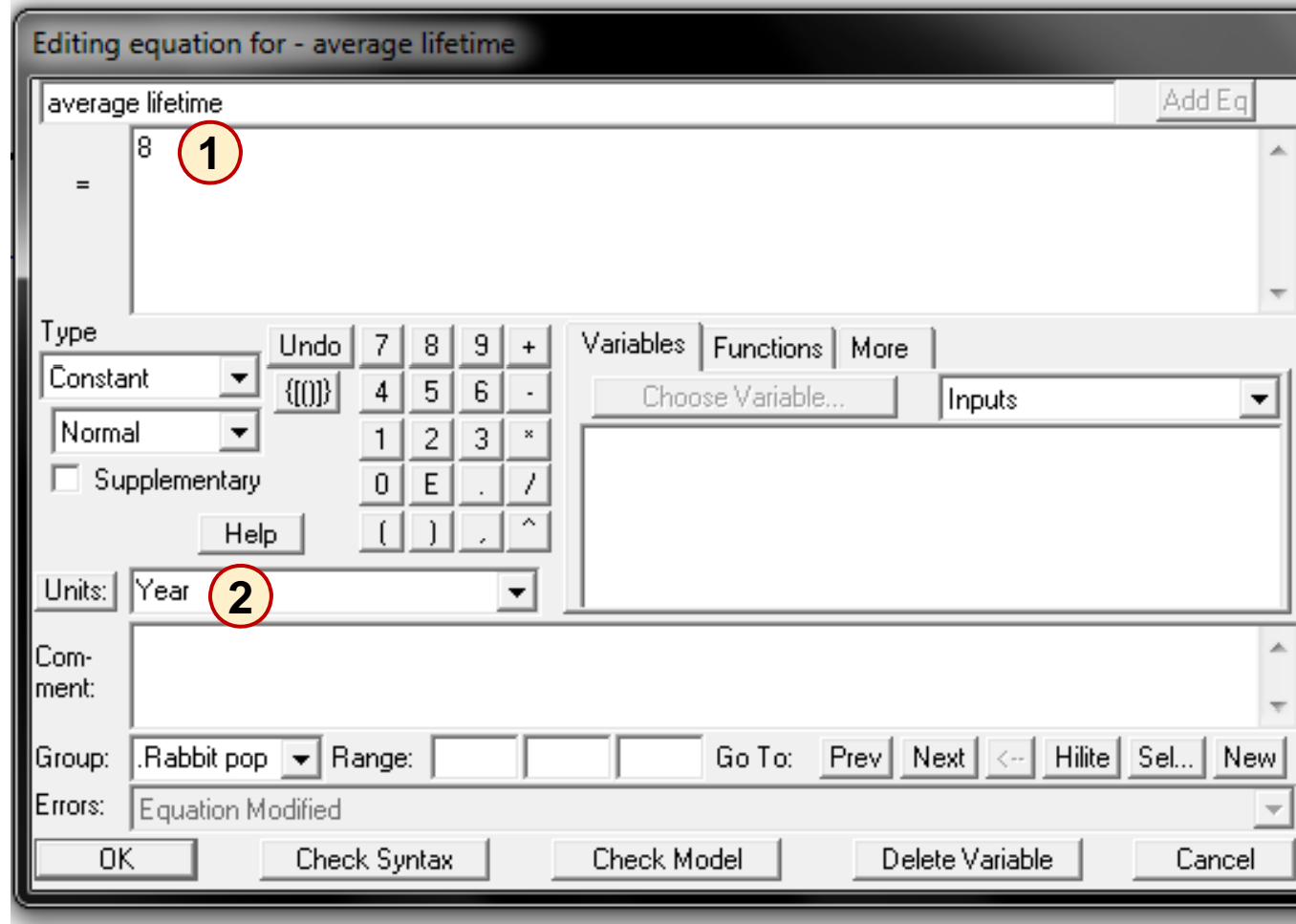
# Variable Type: Constant

## ► *birth rate*



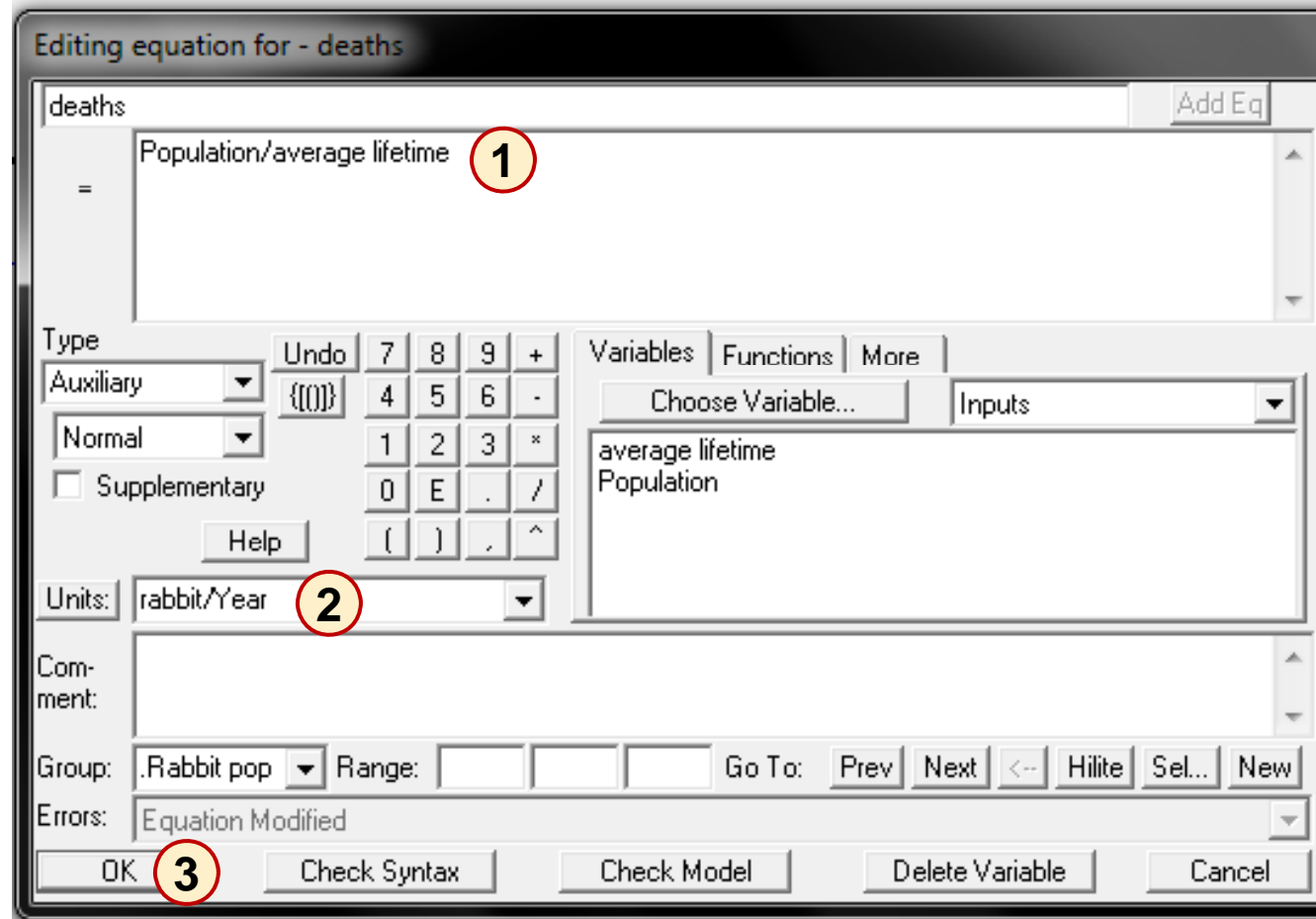
# Variable Type: Constant

## ► *average lifetime*



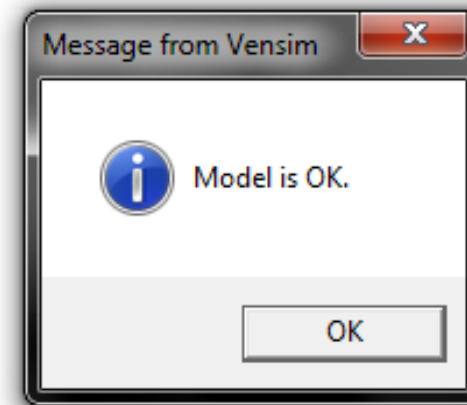
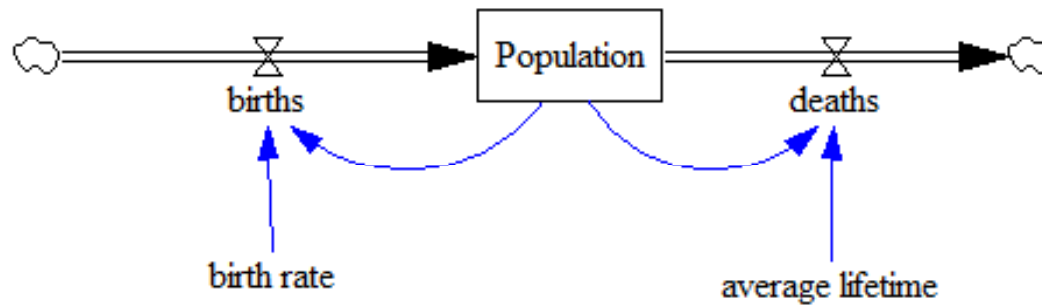
# Variable Type: Auxiliary

- Click on variable *deaths*



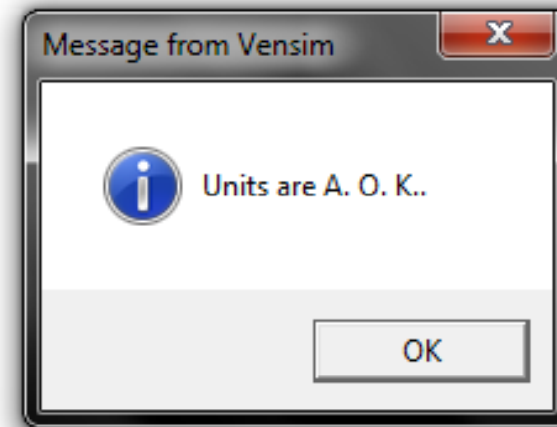
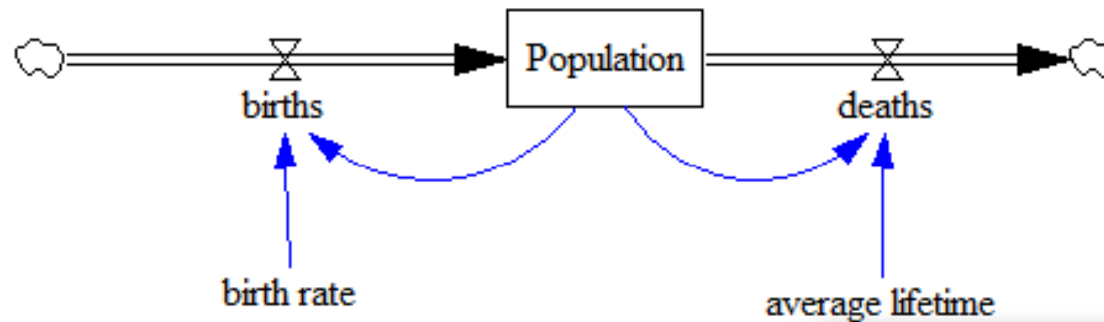
# Checking your model

## ► Model > Check Model



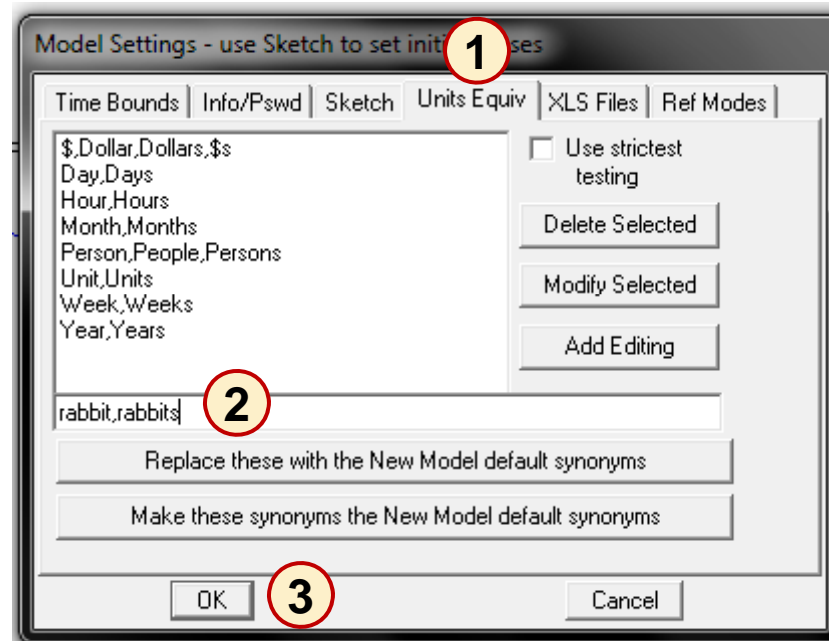
# Checking your model

## ► Model > Units Check

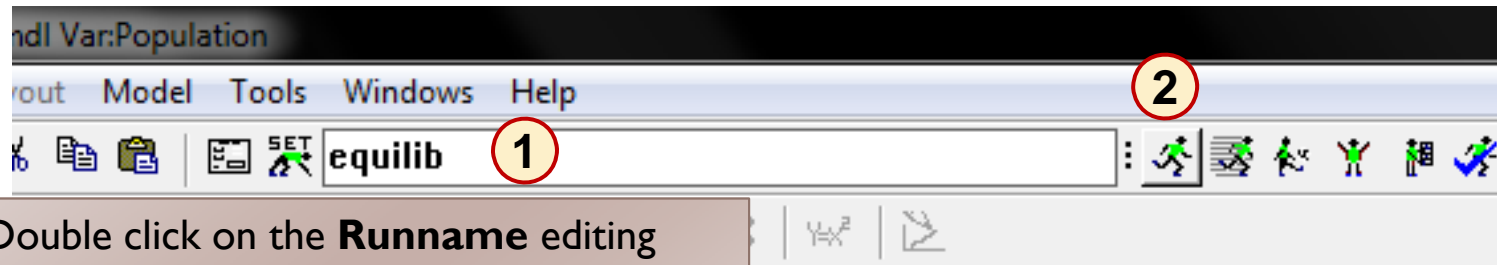


# Unit Equivalents (Synonyms)

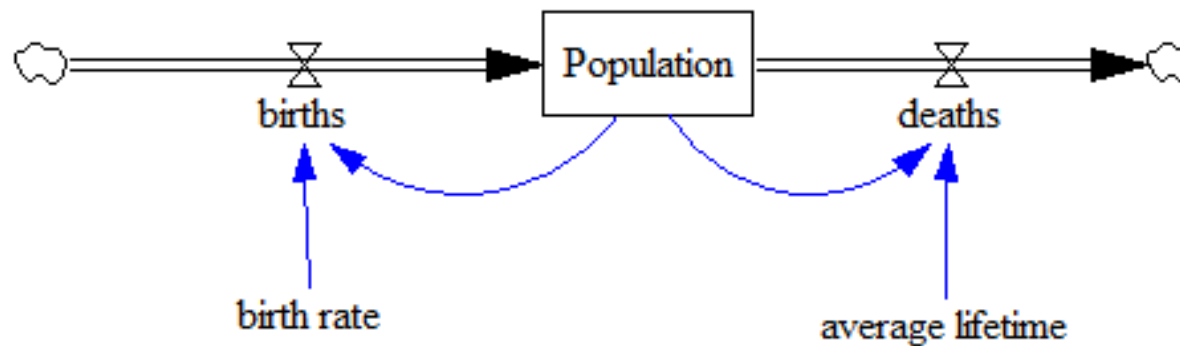
- ▶ Fail in Units check because Vensim does not see the plural form as the same word
- ▶ Model > Settings...



# Simulating the Model



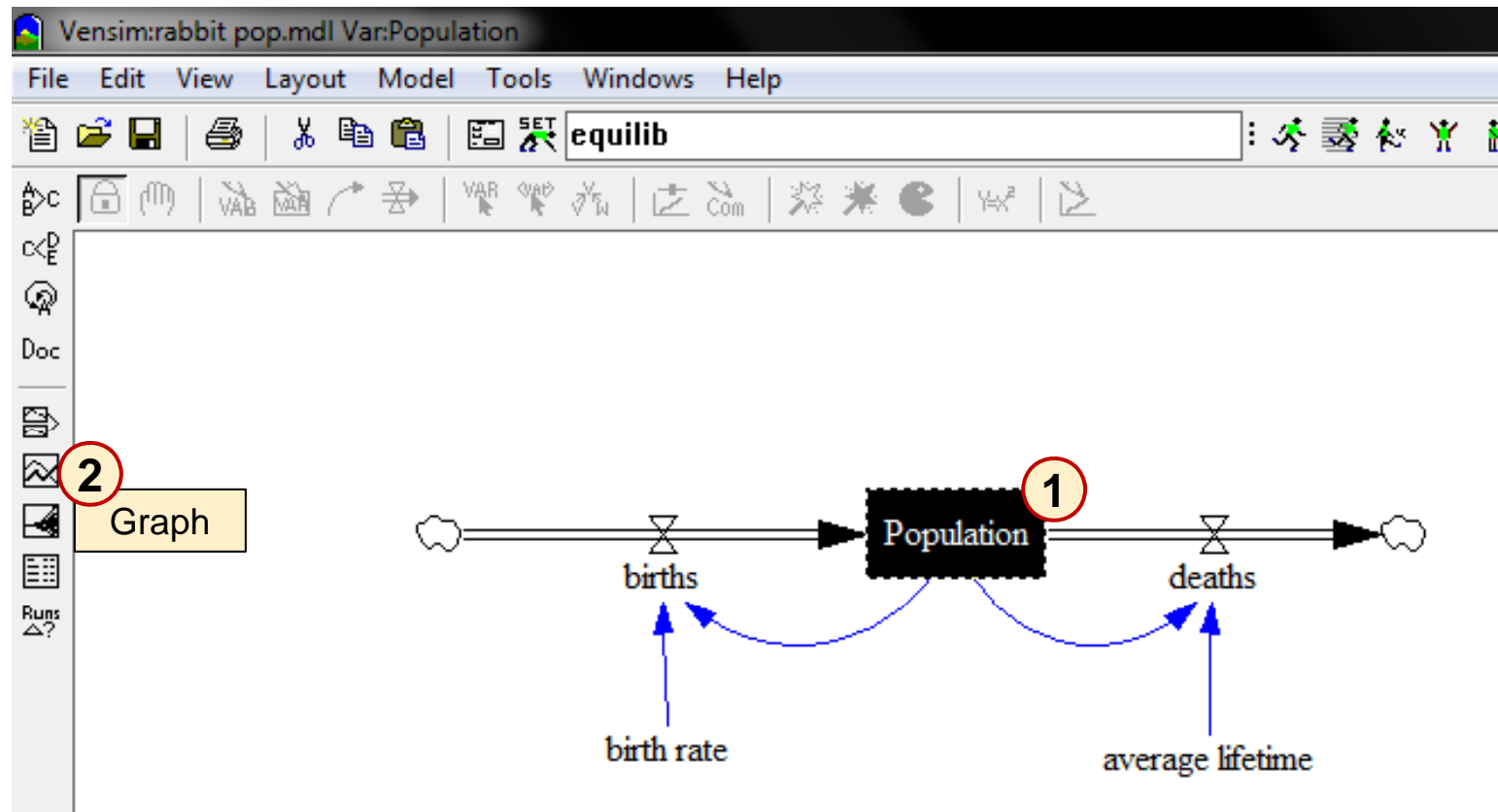
Double click on the **Runname** editing box on the Toolbar and type **equilib** for the first run name.



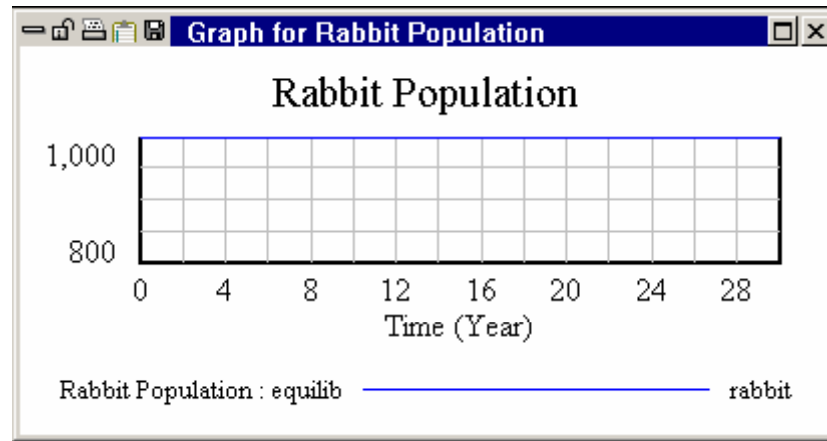



# Model Analysis

- ▶ Click on the Level *Population* in the sketch.
- ▶ Click on the **Graph** tool. A graph of *Population* is generated:



# Model Analysis




- ▶ Population appears as a flat line at the top of the graph at 1000 rabbits. To check that no change is occurring,
- ▶ Click on the **Table** tool 

The Table window displays the following data:

Time (Year)	29.5	29.625	29.75	29.875	30
"Population" Runs:	equilib				
Population	1,000	1,000	1,000	1,000	1,000

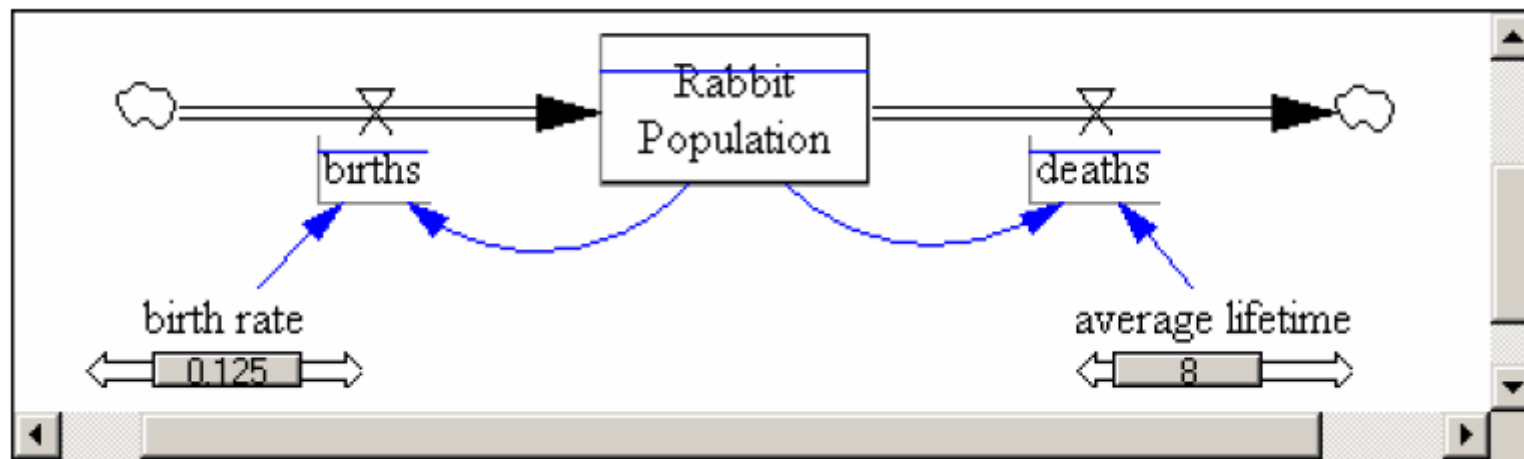
Output window shows that *Population* is unchanging.

# Simulation Experiments

- ▶ Click on the **SyntheSim**  button . Answer yes to whether you want to overwrite the existing run.
- ▶ The toolbar will change to

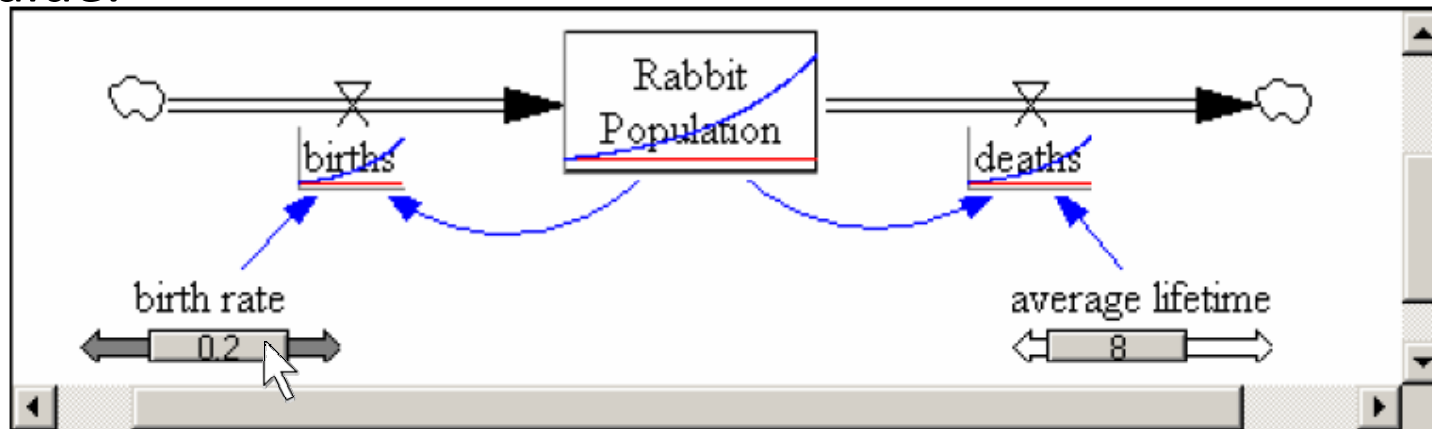


- ▶ and you will see variable behavior for all elements on the diagram.




# Simulation Experiments

- ▶ Click on the **Runname** editing box and replace *equilib* with the name *growth*.
- ▶ Drag the slider beneath birth rate up till it shows 0.2 as its value.



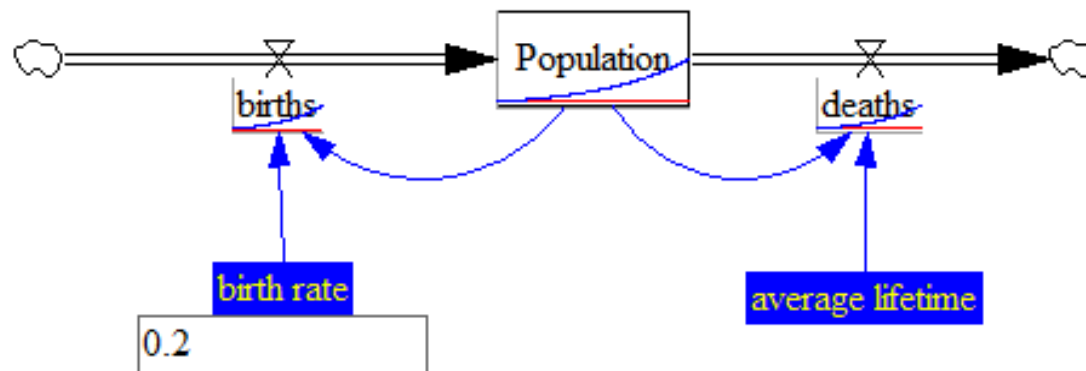
- ▶ The blue lines show the current run and the red line the *equilib* run results.
- ▶ Click on the **Stop** button to stop SyntheSim.
- ▶ View>Show Behavior to see behavior graphs again.

# Alternative Simulation Setup

- ▶ Click on the **Set up a Simulation** button 
- ▶ The Toolbar changes to the simulation toolbar.



- ▶ notice that the constants turn into yellow words with blue background
- ▶ Also, the sketch tools are grayed out, preventing work in the sketch window.

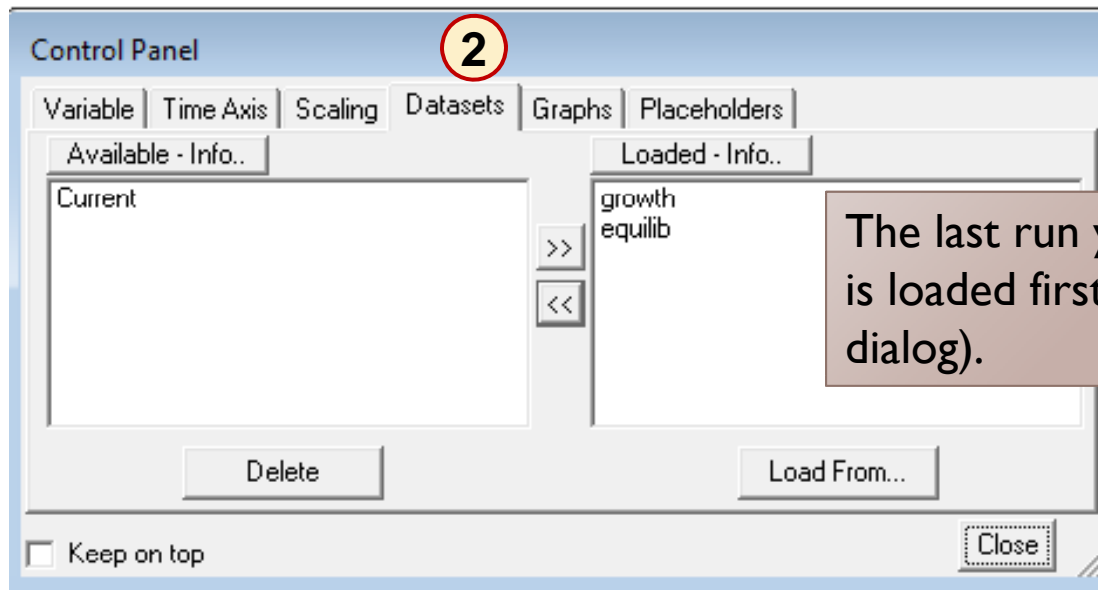


Click on the variable *birth rate* and in the editing box type the value 0.2

This is a temporary change for this run only and does not permanently alter the value in your model.

# Causes Strip Graph

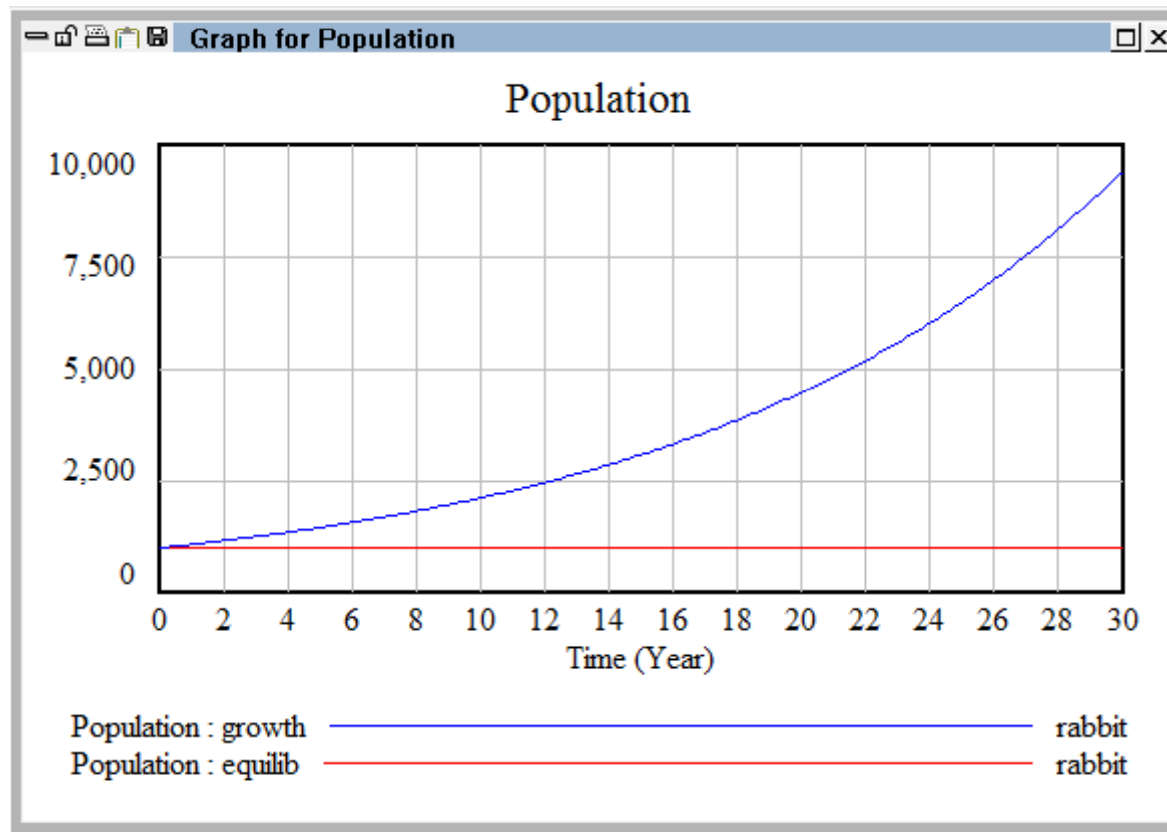
- ▶ Click on *Population* to select it into the workbench.
- ▶ Click on the **Control Panel** button 



The last run you made (*growth*) is loaded first (at the top of the dialog).

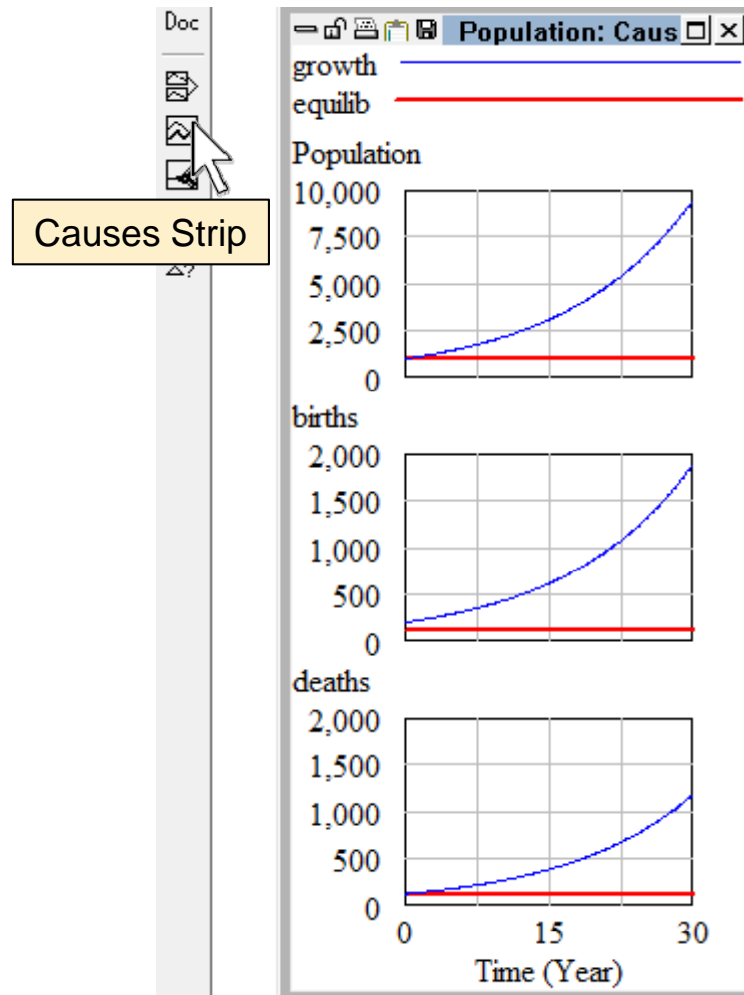
# Causes Strip Graph

- ▶ Click on the **Graph** tool. A graph will show both runs



# Causes Strip Graph

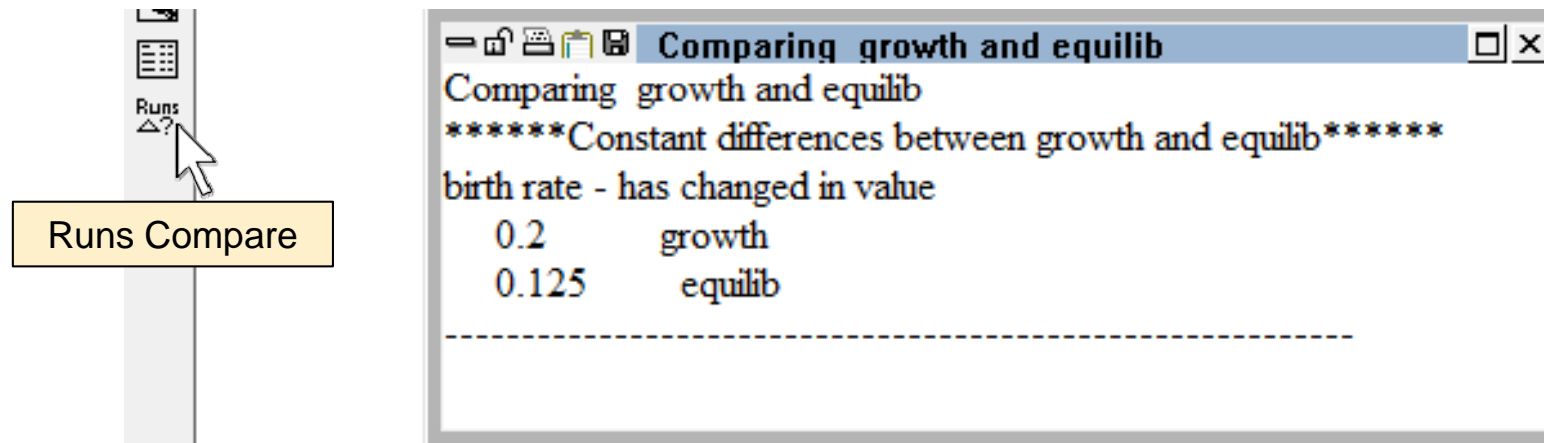
- Now click on the **Causes Strip** tool.





# Runs Compare

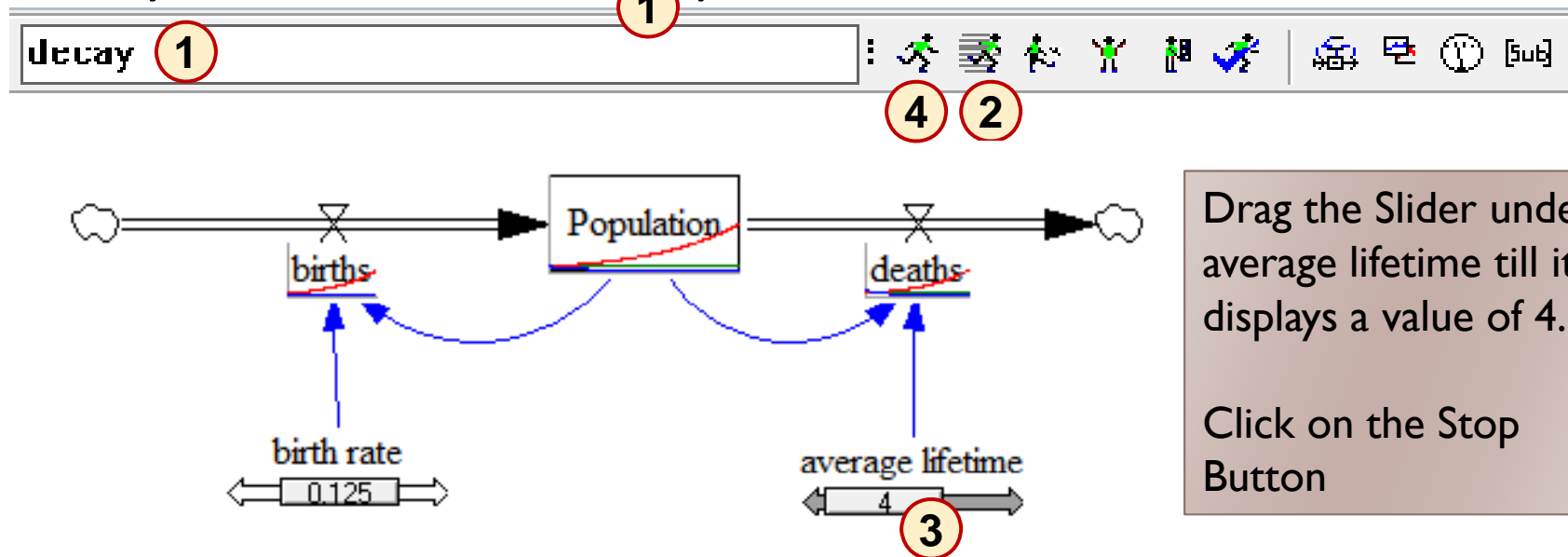
- ▶ Click on the **Runs Compare** tool.
- ▶ shows the differences in the Constant *birth rate* for runs *equilib* and *growth*.



- ▶ Population grew in the *growth* run because the *birth rate* was set to a higher value than the equilibrium value. This made the positive feedback loop through births stronger than the negative feedback loop through deaths, resulting in Population growth over time.

# Exponential Decay

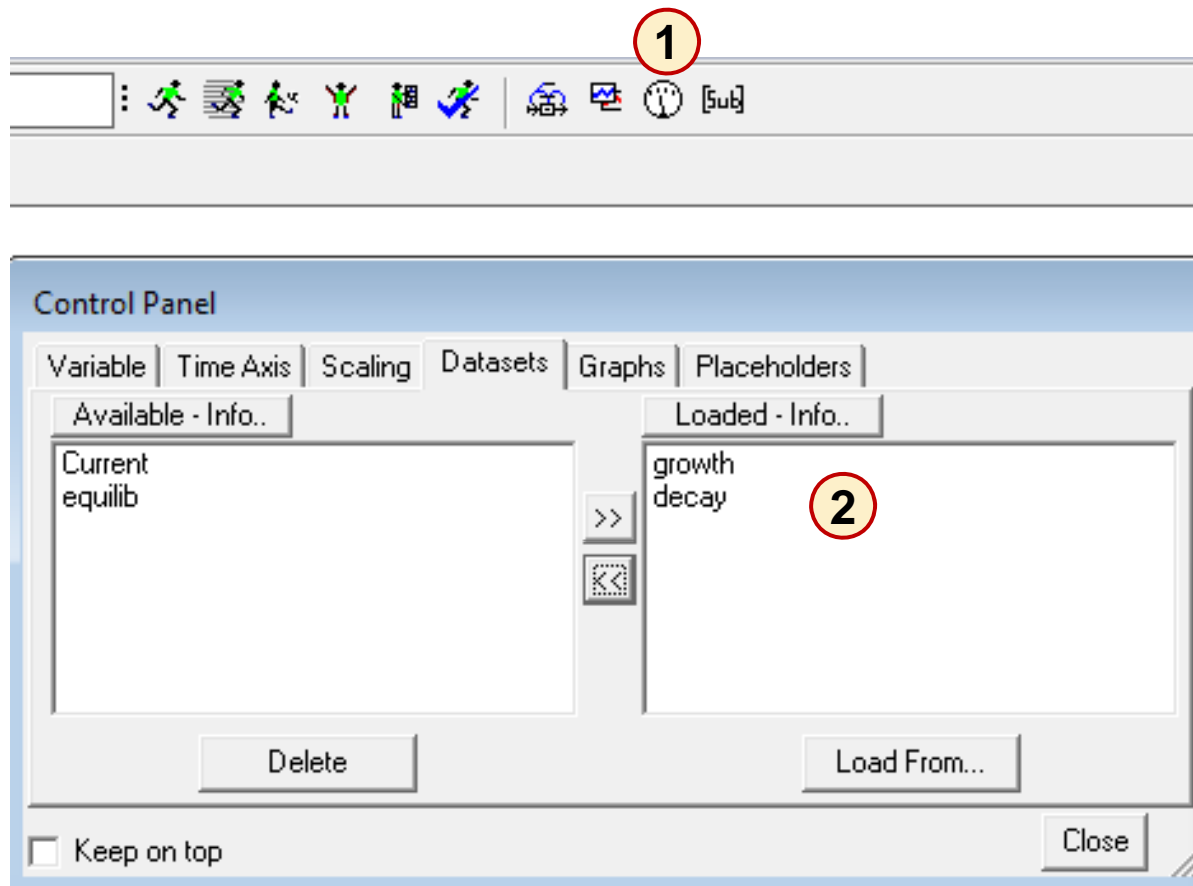
- ▶ make changes to a model Constant to generate exponential decay or decline in the population



- ▶ Click the **Simulate** button and the model will simulate

# Exponential Decay

- ▶ Click on the **Graph** tool and compare the three runs.

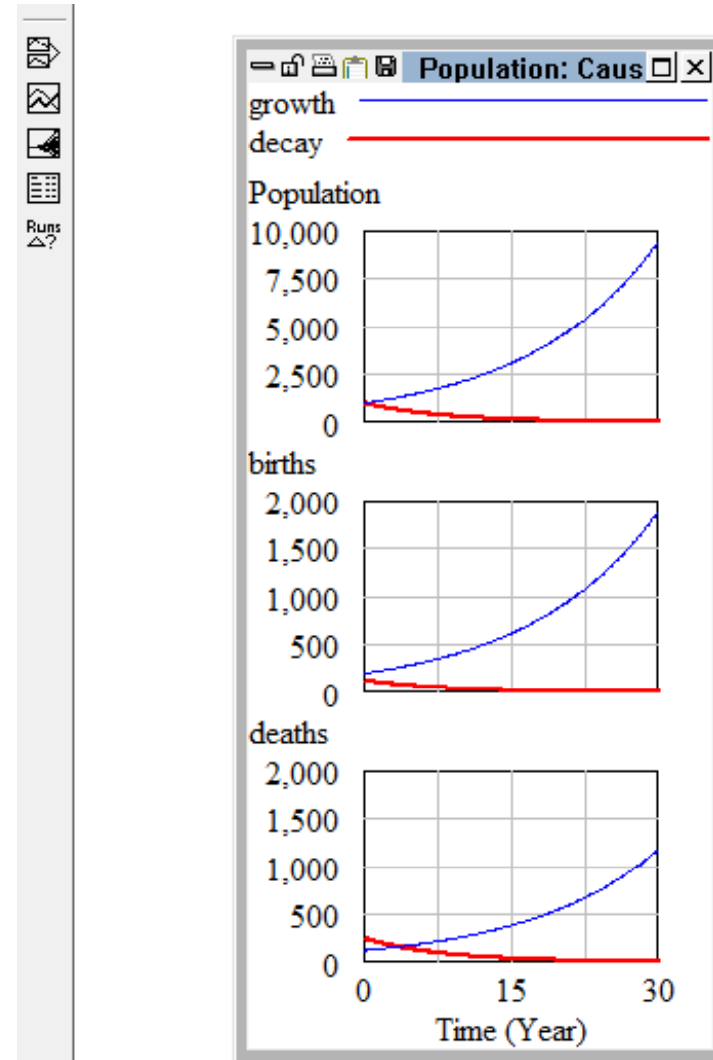


double click  
on the run *equilib* in  
the right box; this will  
unload the run so the  
Analysis tools will  
not examine it.

# Exponential Decay

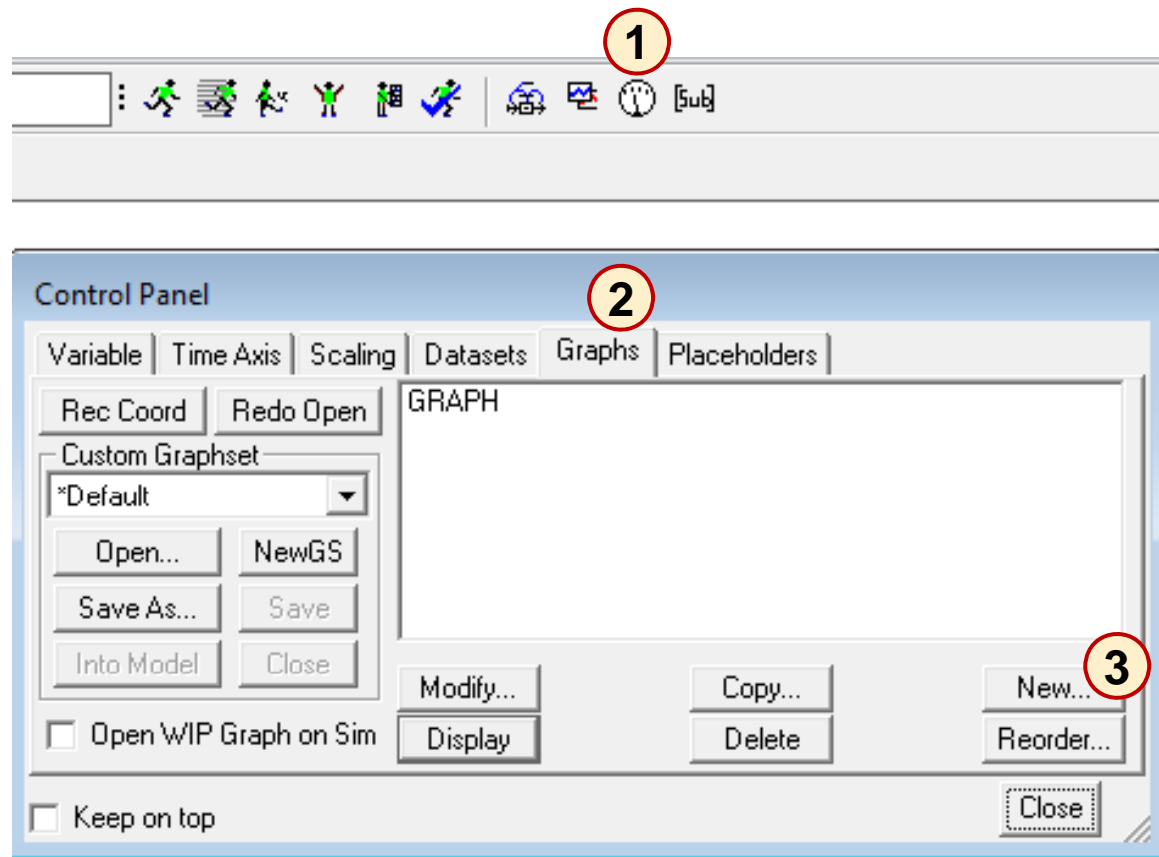
- ▶ Click on the **Causes** Strip tool to show Population and its causes— births and deaths, for the two last runs.

Population declines in the *decay* run because the *average lifetime* was set to a lower value than the equilibrium value. This made the negative feedback loop through deaths stronger than the positive feedback loop through births, resulting in Population decline over time.

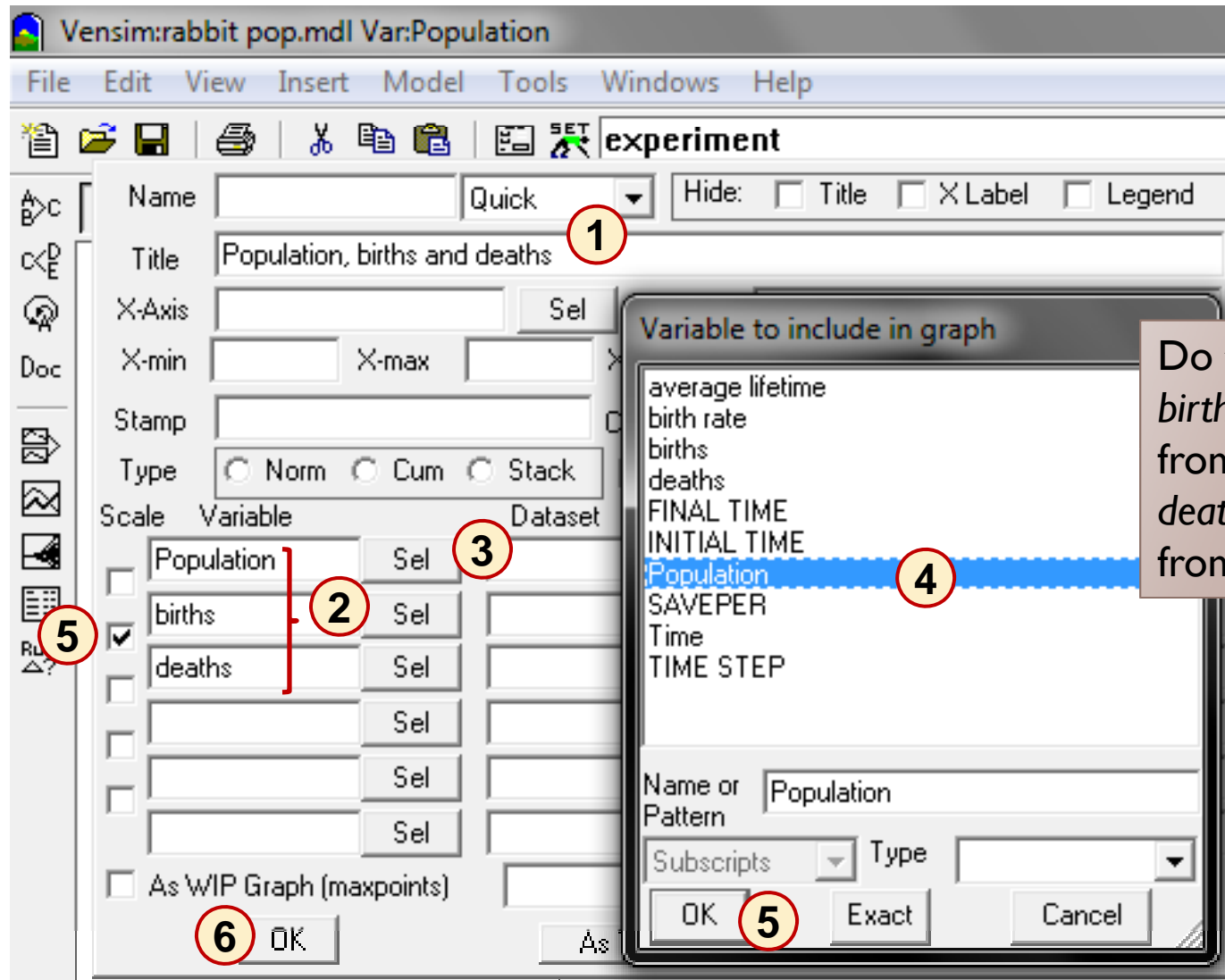


# Input and Output Objects

- ▶ Click on the **Control Panel** button and then select the **Graphs** tab.

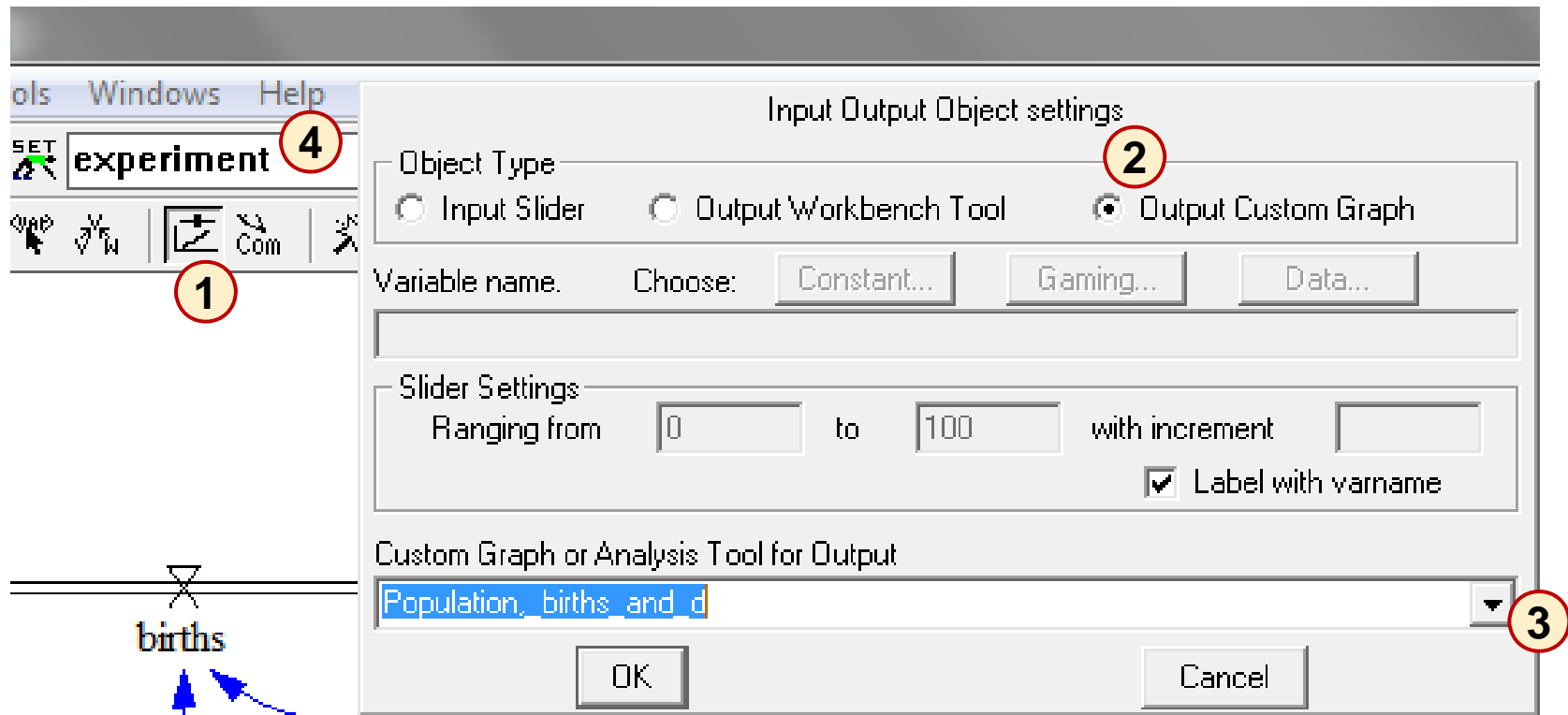


# Input and Output Objects




# Input and Output Objects

- ▶ Select the **Input Output Object** sketch tool



# Input and Output Objects

- ▶ Click the **SyntheSim** button 
- ▶ Experiment with moving the sliders around and seeing the results on the graph.

